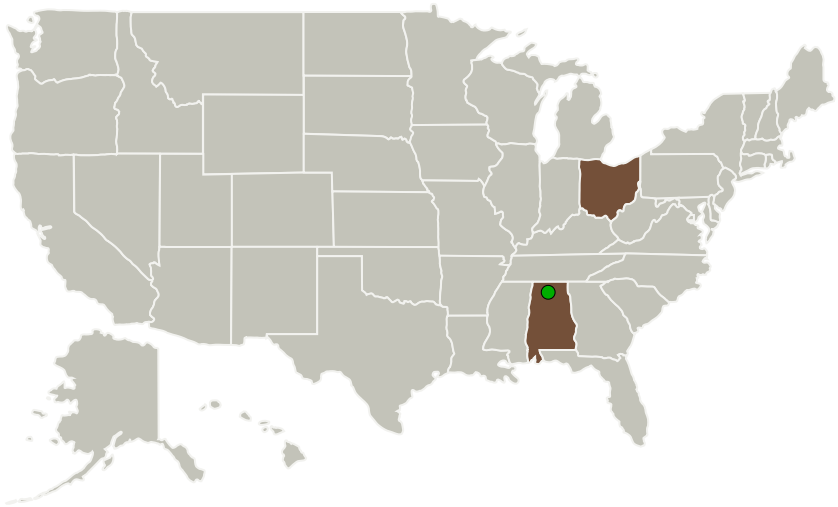
High-Fidelity Prediction of Launch Vehicle Liftoff Acoustic Fields, Phase I

Completed Technology Project (2011 - 2012)

Project Introduction

The high-intensity level acoustic load generated by large launch vehicle lift-off propulsion is of major concern for the integrity of the launch complex and the vehicle payloads. The currently practiced computational methods are unable to offer the reliability of both the noise generation mechanism and acoustic environment. In order to uniquely address both of these critical aspects, the proposed approach will unify the physics of noise production with propagation and structural interactions. This method will utilize hybrid LES/RANS modeling established in NASA production flow solvers (Loci-Chem and OVERFLOW) capable of realistic descriptions of flow-acoustic interactions. A non-dissipative acoustic Boundary Element Method (BEM) will be coupled with the well-resolved noise source for high-quality acoustic environment predictions, equipped with the Fast Multipole Method (FMM) for solution acceleration. In Phase I, merits of the proposed approach will be investigated for plume impingement problems. A high-performance simulation architecture, easy user interfaces and post-processing utilities will be developed for complex geometries and efficient large-scale simulations. Phase II efforts will involve refinements and extensive evaluations for high-resolution noise source modeling, transition of mixed speed flow regimes, wave propagation through non-uniform flow, and supercomputing capabilities facilitating new insights into rocket exhaust acoustic loading and comprehensive noise suppression analysis.

Primary U.S. Work Locations and Key Partners



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Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
University of Cincinnati-Main Campus	Supporting Organization	Academia	Cincinnati, Ohio

Primary U.S. Work Locations	
Alabama	Ohio

Project Transitions

February 2011: Project Start

February 2012: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138409)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CFD Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

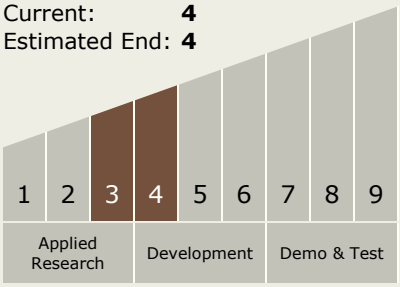
Carlos Torrez

Principal Investigator:

Abhijit Tosh

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.4 Aeroacoustics

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System